EOSTICHOPUS ARNESONI NEW GENUS AND SPECIES (ECHINODERMATA: HOLOTHUROIDEA) FROM THE CARIBBEAN

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ABSTRACT

Eostichopus new genus is erected for stichopodid holothurians whose ossicles include tables having large disks (>60 μm wide) with more than 12 perforations and having spires with two or more crossbeams and spines at every junction of crossbeam with pillar. In *Eostichopus arnesoni* new species, tables have numerous disk perforations (up to 100) and spire crossbeams (up to 10) and there are unique reticulate rods in the tentacles. C-shaped ossicles are also present. *E. arnesoni* is known at present from Puerto Rico and Grenada at moderate depths.

In July 1969 during a cruise of the University of Miami's R/V PILLSBURY, one specimen of a large stichopodid holothurian was taken by trawl off Grenada, W.I. The specimen was examined in April 1979 by one of us (J.E.M.) in the collections of the Rosenstiel School of Marine and Atmospheric Science, University of Miami (UMML) and, although in poor condition, was recognized as probably belonging to a new species. In October 1979, two specimens that are conspecific with the Grenadan specimen were collected by Mr. A. Charles Arneson, University of Puerto Rico at Mayagüez, while he was SCUBA diving off the southwestern coast of Puerto Rico and were turned over to B.M.C. They have now been deposited in the National Museum of Natural History (USNM) as type-specimens.

The calcareous deposits (ossicles) were prepared and photographed by J.E.M., using a NOVASCAN 30 scanning electron microscope.

Eostichopus new genus

Eostichopus Deichmann, 1958: 279—*nomen nudum.*

Diagnosis.—Large Stichopodidae up to 45 cm long. Ventral surface flattened into a distinct sole covered with crowded pedicels with or without obvious linear arrangement. Lateral margins prominent, set with large, simply conical or compound papillae. Dorsal surface arched, covered with large, conical papillae. Mouth directed ventrally; tentacles 20. Ossicles including stout tables with 60–145-μm wide disks having 12–100 peripheral perforations and with spires having 2–10 crossbeams and spines at every juncture of crossbeam with pillar. C-shaped ossicles and reticulate rods present or absent.

Type-Species.—***Eostichopus arnesoni*** new species.

Etymology.—*Eostichopus* is a combination of the Greek *eos,* meaning early, and *Stichopus,* a genus of stichopodid holothurians. The genus is masculine.

Remarks.—Deichmann (1958: 279) presented a key to the genera of the Family Stichopodidae. The key included the new genus *Eostichopus* for stichopodids from the Atlantic with numerous small papillae along the sides of the ventral sole and tables with large disks having several circles of perforations. Unfortunately, Deichmann failed to designate a type-species and thus *Eostichopus* is a *nomen* *nudum* (Clark and Rowe, 1967). We choose to validate the genus in honor of Dr. Deichmann. From her key, it seems possible that Deichmann intended *Eostichopus* to include such species as *Stichopus regalis* (Cuvier, 1817), a congener of *Eostichopus arnesoni* under our interpretation of the genus.

The wide-disked, high-spired tables in species of *Eostichopus* set the genus apart from *Thelenotus* Brandt, 1835 and *Astichopus* Clark, 1922, in which there are no tables in the body wall; from *Neostichopus* Deichmann, 1948 and *Apostichopus* Liao, 1980, in which tables are reduced or rudimentary; and from *Parastichopus* Clark, 1922, *Stichopus* Brandt, 1835 and *Isostichopus* Deichmann, 1958, in which tables are well-developed but with small disks having few perforations and with low spires.

Eostichopus arnesoni new species

?*Astichopus multifidus* (Sluiter, 1910), George and George, 1979: 256, fig. 123/8.

Material Examined.—Holotype: USNM E23938, ♂ 45 × 9 cm, 11.2 km offshore from Punta Aquila, southwestern tip of Puerto Rico on sandy slope at shelf edge, 36 m, collected by A. Charles Arneson, 24 October 1979.

Paratype.—USNM E23939, ♀ 42.5 × 9.5 cm, same data as for holotype; the two specimens collected only 3.6 m apart.

Other Material.—UMML 43:210, one specimen, 16.5 cm (preserved length), R/V PILLSBURY Cruise 6907, Station 857, 12°23.5′N, 61°21.6′W, 1.5 m Blake trawl sampling depths of 9.15–347.7 m, 3 July 1969.

Diagnosis.—Length to 45 cm. Pedicels of ventral surface without distinct linear order. Some large lateral papillae either bifurcate or trifurcate. Tables and C-shaped deposits included in body wall ossicles. Disks of tables with up to 100 perforations. Spires composed of 4–9 (commonly 6) pillars and up to 10 crossbeams with spinose projections at every junction of crossbeam with pillar. Unique reticulate rods included in ossicles of tentacles, one portion of each rod resembling a tall, tapered, spinose spire, the other portion a very irregular three-dimensional meshwork.

Etymology.—We are pleased to name the species for A. Charles Arneson, collector of the type-specimens.

Description.—Holotype: sexually mature ♂, 45 cm long, 9 cm wide (Figs. 1D, E). Tentacles 20, peltate, light brown. Mouth directed ventrally, encircled by collar of small papillae. Lateral and dorsal surfaces convex, covered with large (up to 2 cm high), conical papillae in a double row along each flank and in about 8 indistinct, longitudinal rows dorsally. Some papillae at margin of ventral sole bifurcate or trifurcate. Ivory-white ring at base of each papilla; tips of papillae light brown. Body wall between papillae light chocolate brown. Ventrum flat, densely covered with pedicels without distinct linear arrangement; bright crimson in life, faded to cream color in alcohol. Cloacal opening surrounded by discrete large and small papillae. Gonad, branched testes filled with mature sperm.

OSSICLES OF TENTACLES. (1) spiny rods (Figs. 2N, O) 110–660 μm long; (2) unique reticulate rods (Fig. 2A) 124–325 μm long and up to 60–70 μm in diameter, one half or more of length of each rod in form of tall, tapered, spinose spire, the other portion an irregular mesh; (3) rare spiny rosettes.

OSSICLES OF BODY WALL, PAPILLAE AND PEDICELS. (1) numerous C-shaped deposits (Figs. 2J, K) 50–100 μm long; (2) a few irregular C deposits (Figs. 2I, L) in shape of X, S, Y or irregular rosette, 55–180 μm long; (3) numerous tables

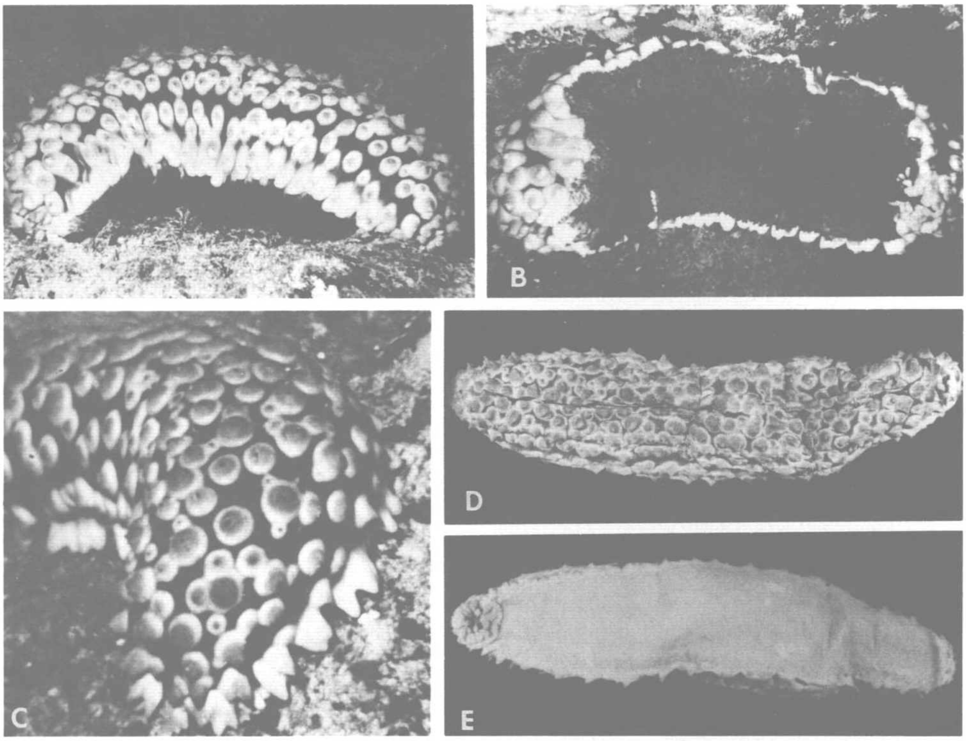

Figure 1. *Eostichopus arnesoni* new genus, new species. A–C, paratype (USNM E23939), 42.5 × 9.5 cm, lateral, ventral and anterior views, *in situ*; D–E, holotype (USNM E23938), preserved, 45 × 9 cm, dorsal and ventral views.

(Figs. 2B–H) 55–125 μm high and 80–145 μm across disk; spires comprising 4–9 (4 rarely, 6 commonly) pillars, 2–10 crossbeams connecting adjacent pillars, and 2–3 smooth or dentate spines at each juncture of crossbeam with pillar; disks having 4–9 (typically 6) central perforations and up to 100 small peripheral perforations and margins varying from smooth and wide to scalloped and narrow; (4) in anterior papillae only, a few perforated plates 140–225 μm long; (5) in pedicels only, spinose, slightly curved rods (Fig. 2M) 300–625 μm long, some with irregular, occasionally elaborate, perforated central expansions.

OSSICLES FROM SEVERAL INTERNAL STRUCTURES. (1) tentacle ampullae, fairly smooth deposits in shape of C, S, X, Y or J and rods with ends either smooth and acute or curved and spiny, 50–300 μm long, oriented perpendicular to the long axis of ampulla; (2) gonad, delicate spiny rods 55–110 μm long, most with ends slightly curved and(or) bifurcate, many curved into C shape; (3) respiratory trees, elaborate tables (Figs. 3A–D) with spires comprising complex, fenestrate, spinose pillars not connected by crossbeams and with spinous disks having several large central perforations surrounded by numerous smaller perforations; also other complicated, far more irregular deposits.

PARATYPE: sexually mature ♀ (Figs. 1A–C) 42.5 cm long, 9.5 cm wide. External features virtually identical to those of holotype except for slightly wider ivory-white rings at bases of papillae. Ossicles of tentacles, body wall, papillae and pedicels same as in holotype.

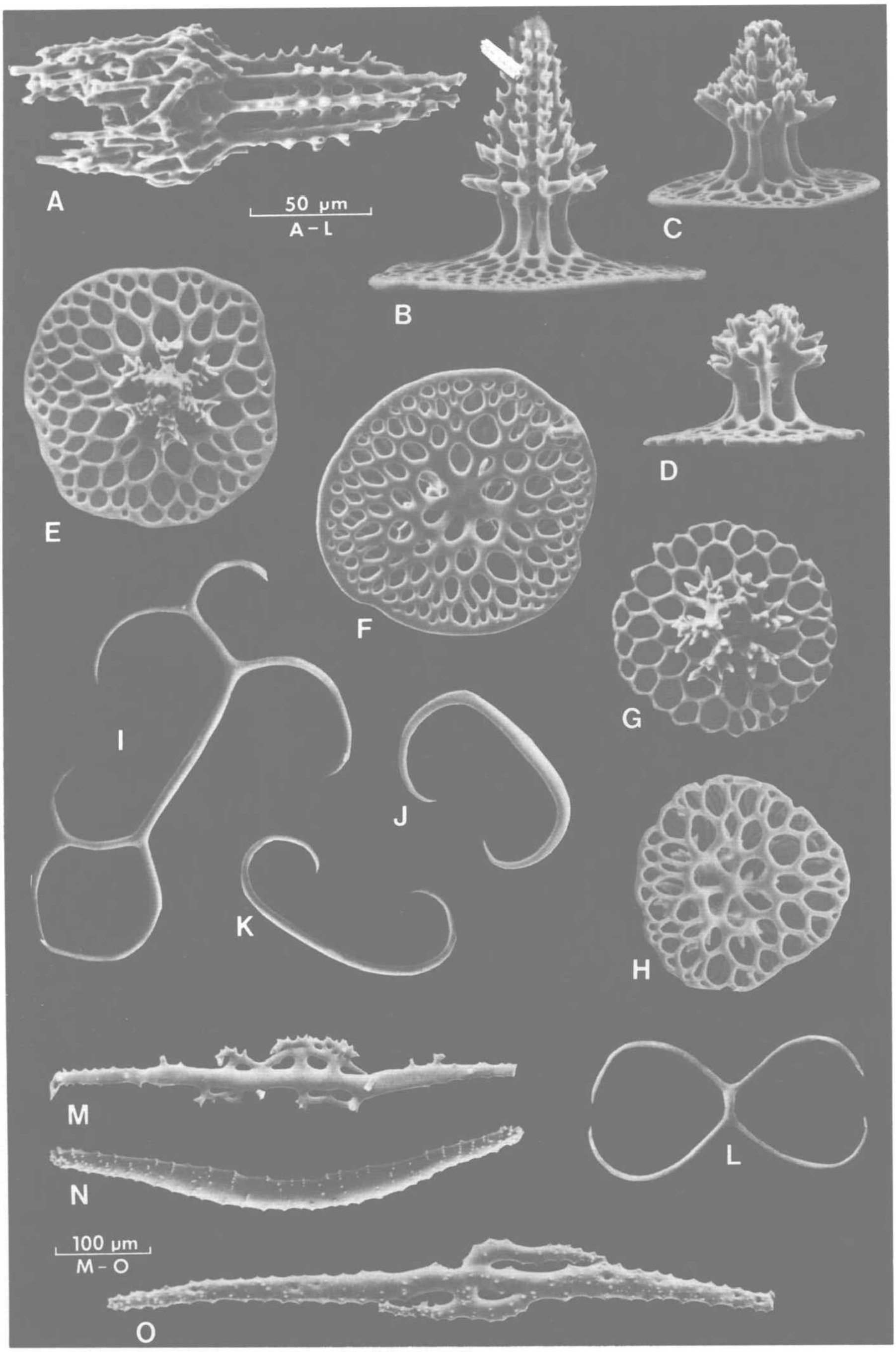

Figure 2. Ossicles of *Eostichopus arnesoni* new genus, new species. A, reticulate rod; B–D, tables with high, medium and low spires, lateral views; E–F, tables having disks with wide, smooth margins, upper and lower views; G–H, tables having disks with narrow, scalloped edges, upper and lower views; I–L, C-shaped and irregular C-shaped deposits; M–O, rods. A, N, O from tentacles; B, D, E, G, H, K from mid-dorsal papillae; C, F, I, J, L, M from mid-ventral pedicels.

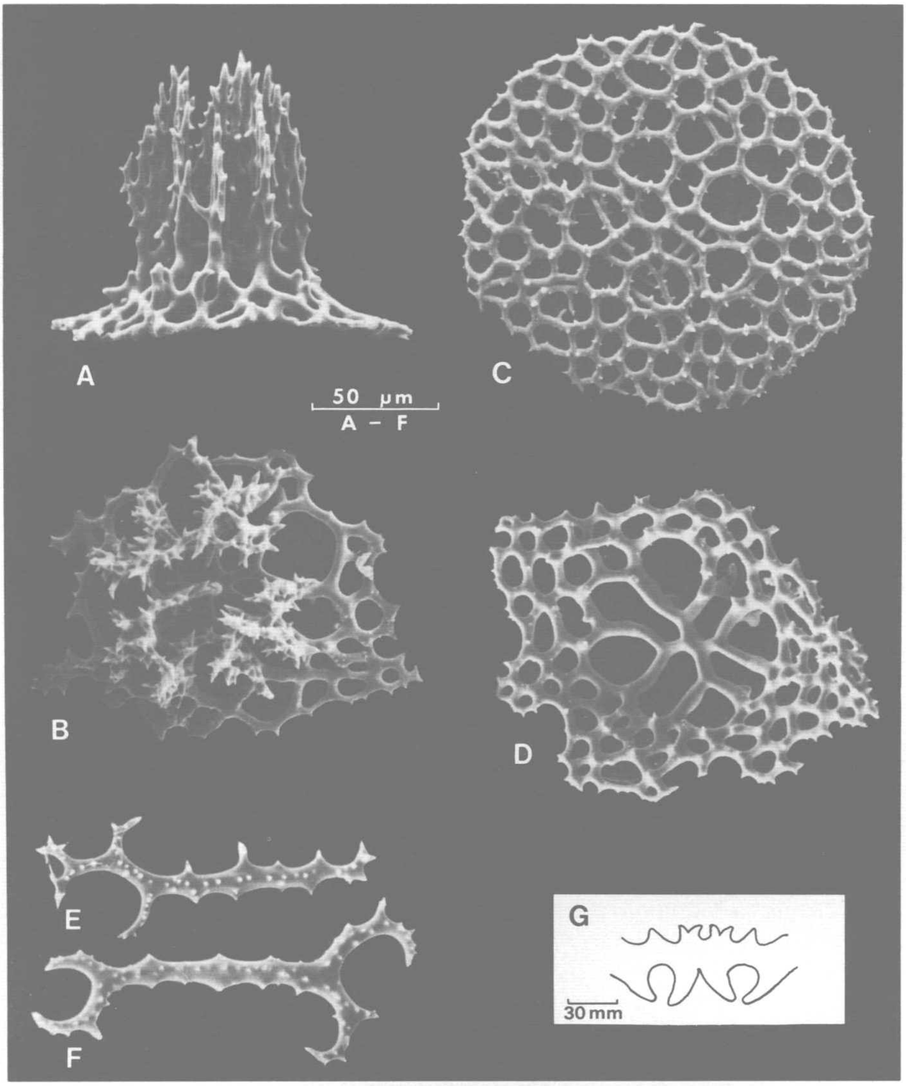

Figure 3. Scale should read 10 mm not 30 mm as shown. Ossicles of internal structures and calcareous ring of paratype of *Eostichopus arnesoni* new genus, new species. A–B, tables from respitory tree, views from side and top of spire; C–D, disks of tables from respiratory tree; E–F, rods from gonad; G, two interradial pieces and one radial of the calcareous ring.

Radial pieces of calcareous ring (Fig. 3G) approximately 15 mm long, with four anterior lobes, a wide central notch and 2 long, curved posterior projections. Interradials one-half length of radials, with single anterior projection and concave posterior margin.

Tentacle ampullae approximately 55 × 3 mm; walls with ossicles like those in ampullae of holotype.

Polian vesicle single, clavate, with slightly narrowed distal end, 30 mm long, to 11 mm wide. Walls with rods 110–215 μm long, most with branched and/or spiny ends, majority aligned more or less parallel to longitudinal axis of vesicle.

Stone canal single, 10 mm long, 5 mm wide, clavate, rugose distally, attached to dorsal mesentery.

Gonad in two tufts, one on either side of dorsal mesentery, branched, filled with mature eggs up to 125 μm in diameter. Wall of gonad with ossicles much like those of holotype except that spiny rods (Figs. 3E, F) are up to 165 μm long and not so commonly curved into C shapes. All deposits more or less aligned parallel to longitudinal axis of tubules.

One finely branched respiratory tree on either side of body; right tree longer than body length, left tree somewhat less than body length. Walls of trees with ossicles like those of holotype.

Remarks.—A specimen indicated as *Astichopus multifidus* in George and George (1979) appears to belong to *Eostichopus arnesoni*. It was photographed by D. Clarke at a depth between 18–42 m off the south shore of Grand Bahama Island. The specimen was not collected.

E. arnesoni is apparently rare. With such striking coloration and large body size, it seems unlikely that this species could have been overlooked by previous investigators. A cursory examination of the skeletal ossicles clearly separates *E. arnesoni* from other members of the Stichopodidae in the western Atlantic.

Like *E. arnesoni, Stichopus regalis* (Cuvier, 1817) and *Stichopus owstoni* Mitsukuri, 1912 possess tables with wide disks having numerous perforations and with spires having 2 or more crossbeams and spines at every junction of crossbeam with pillar. Thus these species are included herein under *Eostichopus* as new combinations.

In *Eostichopus regalis,* the spire is consistently supported by 4 pillars and has no more than 5 crossbeams. The disks (60–105 μm wide) have a maximum of about 50 perforations.

In *Eostichopus owstoni,* the spire is composed of 3–8 (commonly 4–5) pillars and apparently no more than 2 crossbeams. The disks, although wide (0.06–0.85 mm according to Mitsukuri; latter dimension is probably an error and should read 0.085 mm) have fewer holes than in *E. arnesoni* or *E. regalis*. There are 1–4 Polian vesicles in *E. owstoni,* one each in the other 2 species. Unlike *E. arnesoni,* both *E. regalis* and *E. owstoni* lack C-shaped ossicles and reticulate rods.

The type-locality of *Eostichopus regalis* is in the Mediterranean. Specimens have also been reported from the eastern Atlantic (Bay of Biscay, Canary Islands, west coast of Ireland, west coast of Africa) and from the western Atlantic (northern coast of Cuba, Virgin Islands). *E. owstoni* at present is known only from Japanese seas.

Stichopus flaccus Liao, 1980, found in the Gulf of Tonkin, China, possibly also belongs in *Eostichopus*. In the papillae of that species, there are large tables described as having 4 pillars, 2–3 crossbeams and disks about 100 μm wide. The numbers of holes in the disks are not given, however. In the illustrations of the tables, there appear to be spines at the junctions of crossbeams and pillars, but the spires are considerably more irregular than in the other 3 species of *Eostichopus*. In addition to large tables, *S. flaccus* has small, delicate tables, C-shaped ossicles, rosettes and, in the pedicels, slender supporting rods. There are no reticulate rods in the tentacles such as are found in *E. arnesoni*.

Including *Eostichopus arnesoni,* 4 valid species belonging to Family Stichopodidae are now known from the western Atlantic and Caribbean. These are included in the following key.

KEY TO THE SPECIES OF STICHOPODIDAE FROM THE WESTERN ATLANTIC

1a. Small C-, O- or S-shaped or irregularly curved ossicles and numerous minute grains present in body wall; tables absent .... *Astichopus multifidus* (Sluiter)
1b. Tables included in ossicles of body wall 2a
2a. Disk of tables with a single ring of 8–12 peripheral perforations, spire with single crossbeam; C-shaped ossicles present .... *Isostichopus badionotus* (Selenka)
2b. Disk of tables with several rings of perforations, spires with 2 or more crossbeams; C-shaped ossicles present or absent 3a
3a. Spire of tables with 4–9 (4 rarely, 6 commonly) pillars and up to 10 crossbeams; C-shaped ossicles numerous; reticulate rods present in tentacles .... *Eostichopus arnesoni* new genus, new species
3b. Spire of tables composed of 4 pillars and up to 5 crossbeams; C-shaped ossicles and reticulate rods absent .... *Eostichopus regalis* (Cuvier) new combination

Few authors have mentioned the presence of ossicles in the internal organs of holothurians. Mitsukuri (1912) noted simple, curved rods from genital and intestinal walls and illustrated fenestrated disks, apparently with some fine surface spinulation, from the cloacal wall in *Stichopus japonicus* Selenka, 1867. He also mentioned "beautifully complex calcareous deposits" in the cloacal wall and respiratory trees of his *Stichopus owstoni* n. sp.

Liao (1980) illustrated the same sort of complex (multibranched and anastomosed) plates from the cloacal wall of *S. japonicus,* which he referred to *Apostichopus* n. g.; ossicles were not found in other internal organs. From *Stichopus chloronotus* Brandt, 1835, Liao illustrated and described "rod-shaped, smooth or thorny bodies" in the cloacal wall and a "lot of rod-shaped and X-shaped bodies" in other internal organs.

Among the western Atlantic Stichopodidae, the ossicles in the respiratory trees and cloacal wall appear to be particularly characteristic. In *Astichopus multifidus,* there are stout, straight rods covered with acute spines, both short and long. In *Isostichopus badionotus,* there are stout, mostly smooth, rods with numerous branches, some of which anastomose. Both *Eostichopus arnesoni* and *E. regalis* possess delicate and elaborate fenestrate plates with spinous surfaces. *E. arnesoni* has also complex tables, apparently absent in *E. regalis.*

ACKNOWLEDGMENTS

The authors are grateful to Mr. A. C. Arneson for collecting and allowing us to study the two beautiful specimens that are designated here as type-specimens of *Eostichopus arnesoni.* We wish also to thank Dr. D. L. Pawson, National Museum of Natural History, Smithsonian Institution and Dr. F. W. E. Rowe, The Australian Museum for critically reviewing the manuscript. Loan of the PILLSBURY specimens was made possible by Mr. R. Toll, University of Miami, Rosenstiel School of Marine and Atmospheric Science. We are grateful to Ms. J. Piraino, Smithsonian Institution, Ft. Pierce Bureau for assisting in SEM photography. This paper represents a Contribution of the Department of Marine Sciences, University of Puerto Rico at Mayagüez and Contribution No. 257 from Harbor Branch Foundation, Inc.

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DATE ACCEPTED: November 5, 1981.

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